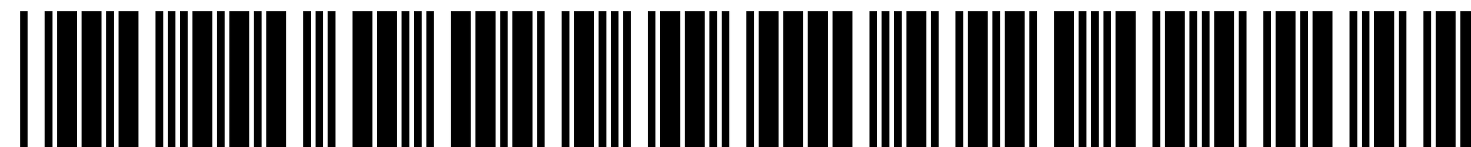

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Kim et al.

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(45) **Date of Patent: Jul. 8, 2014**

(54) **DRIVER PACKAGE**

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(73) Assignee: **LG Display Co., Ltd.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 232 days.

(21) Appl. No.: **13/433,178**

(22) Filed: **Mar. 28, 2012**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H05K 7/20 (2006.01)

(52) **U.S. Cl.**
USPC **361/713**; 361/704; 361/719; 361/720; 257/712; 257/713; 165/80.3

(58) **Field of Classification Search**
None
See application file for complete search history.

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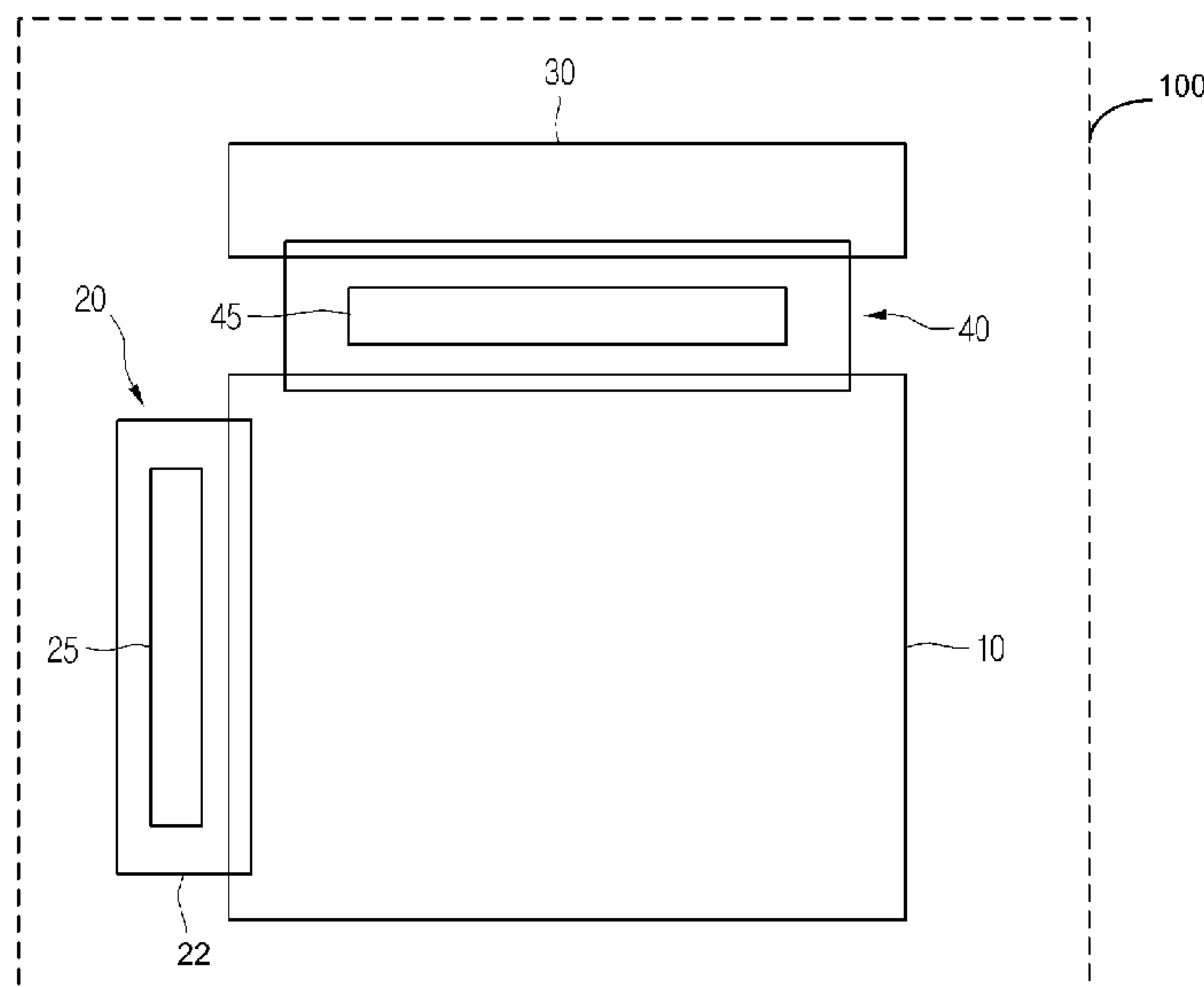
(57) **ABSTRACT**

A driver assembly with an efficient mechanism for transferring heat away from an integrated circuit (IC) chip via a heat transfer member and conductive pattern lines formed on a substrate. The IC chip is mounted on connectors and is placed above the substrate. The IC chip operatively communicates with the display panel via at least a subset of the conductive pattern lines and a subset of the connectors. A heat transfer member is formed on the substrate and is configured to transfer heat generated by the integrated circuit to a component having a lower temperature than the IC chip. A heat transfer element is placed between the IC chip and the heat transfer member to transfer the heat generated by the IC chip to the heat transfer member.

20 Claims, 4 Drawing Sheets



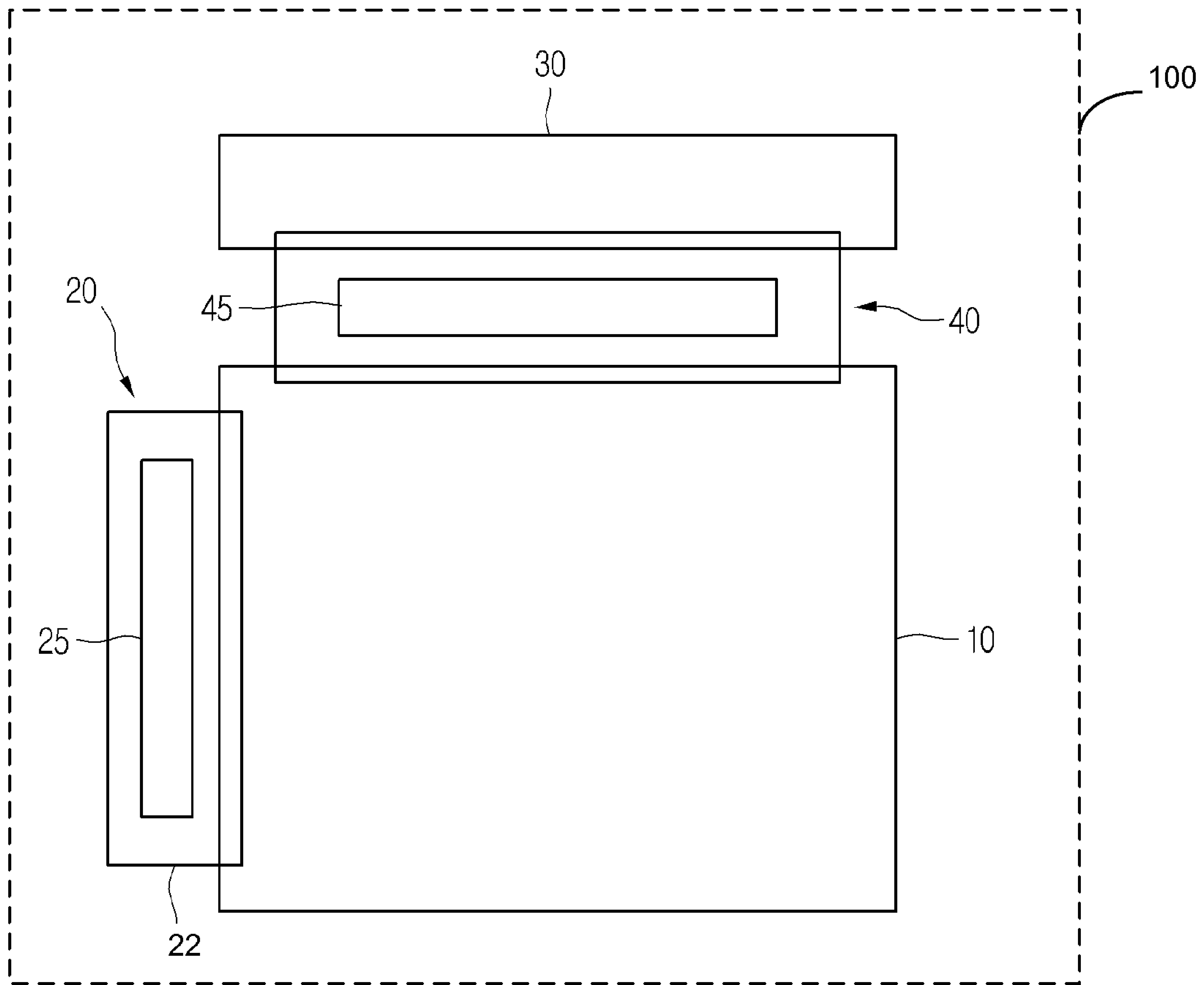


FIG. 1

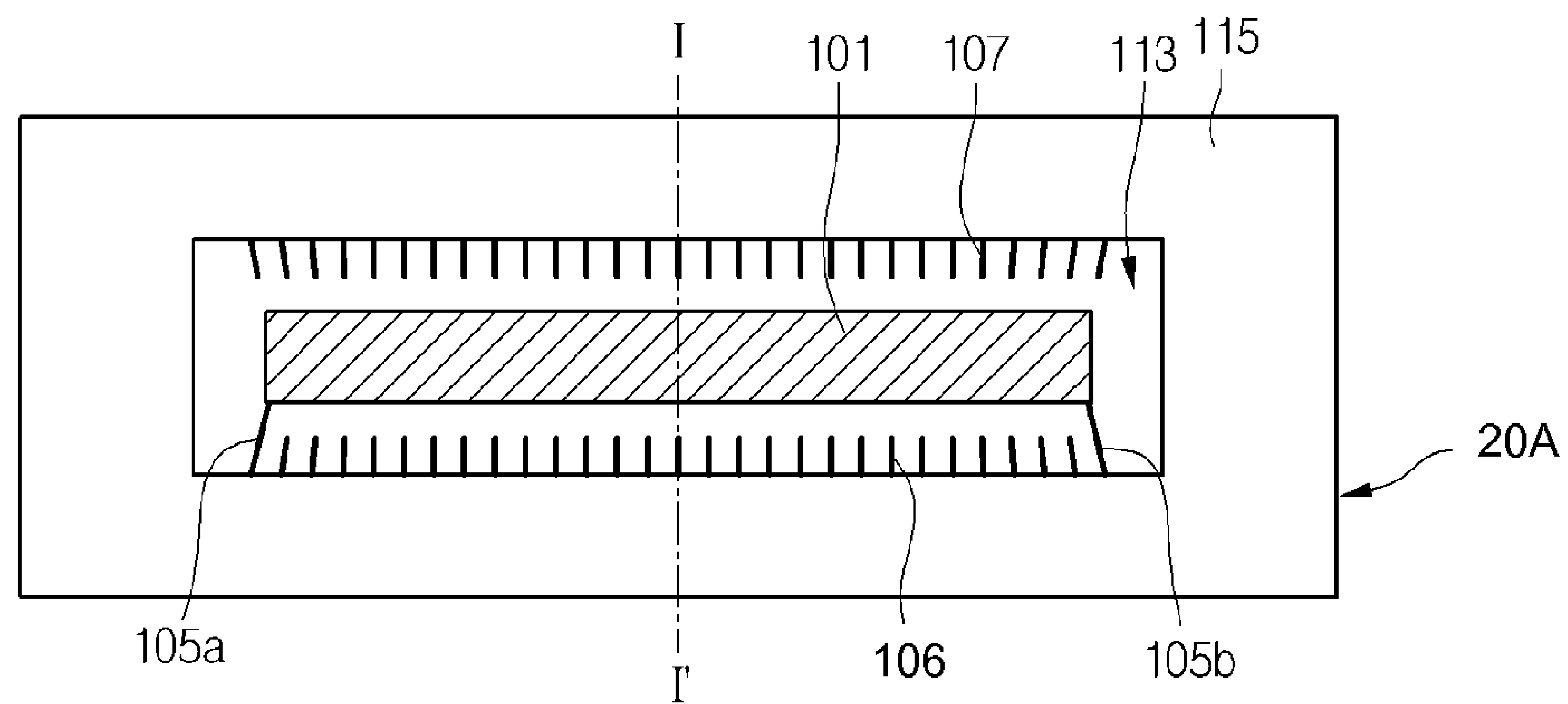


FIG. 2

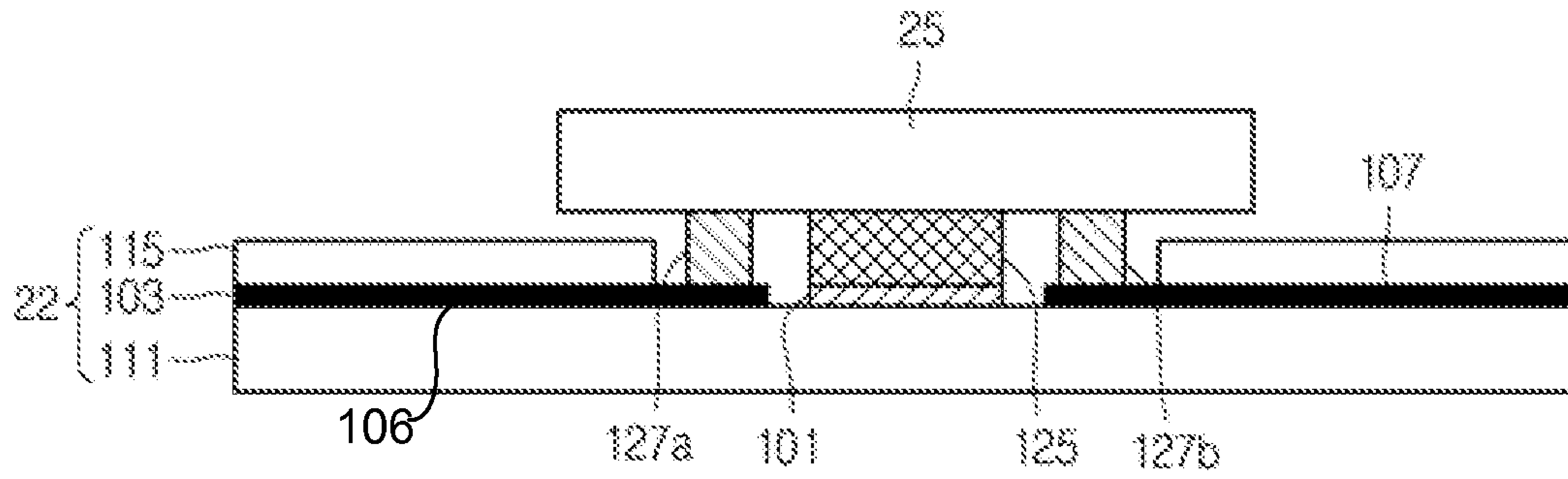


FIG. 3

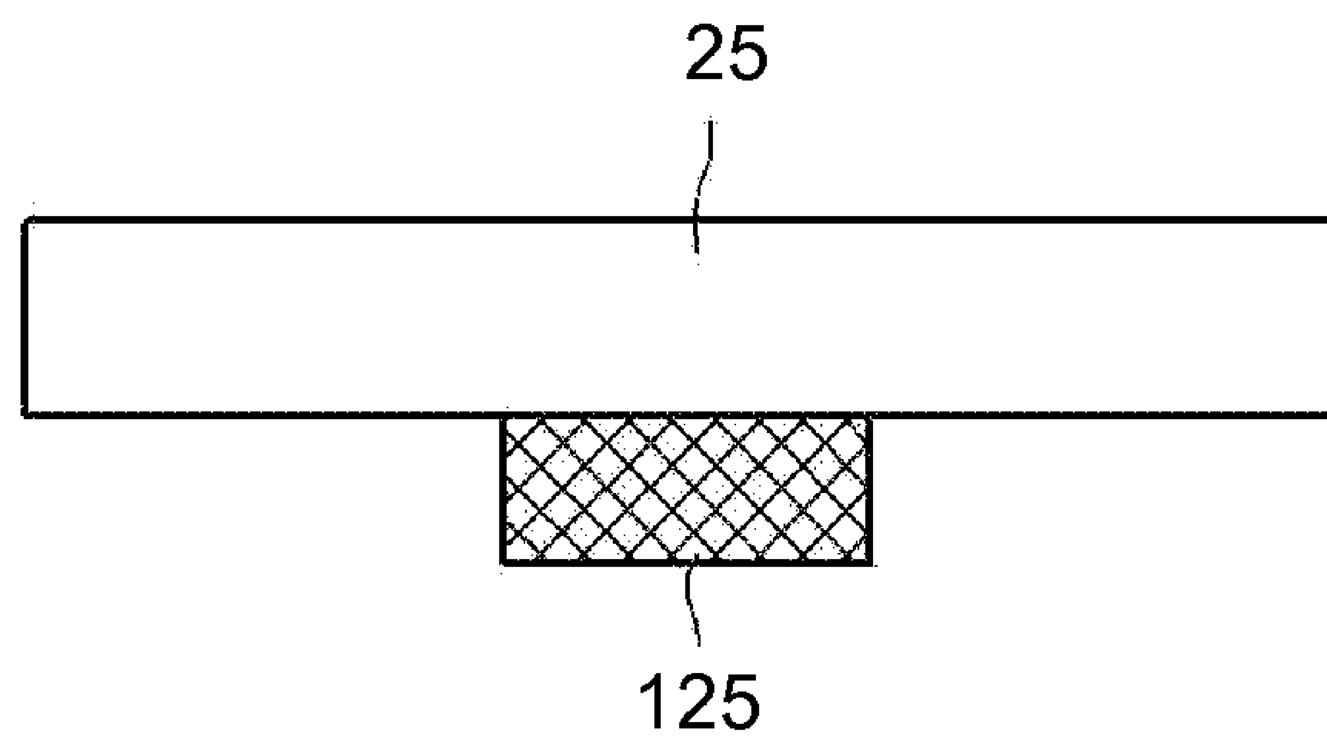


FIG. 4

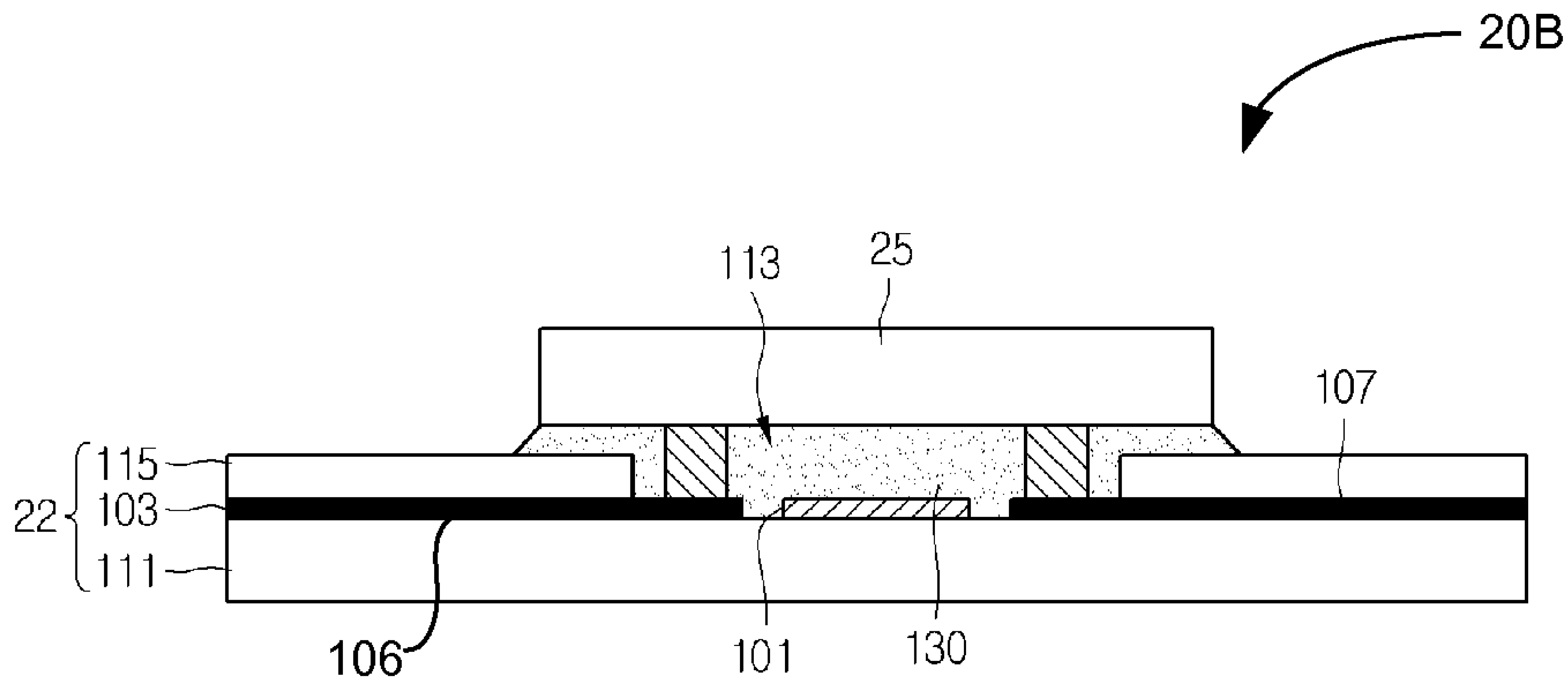


FIG. 5

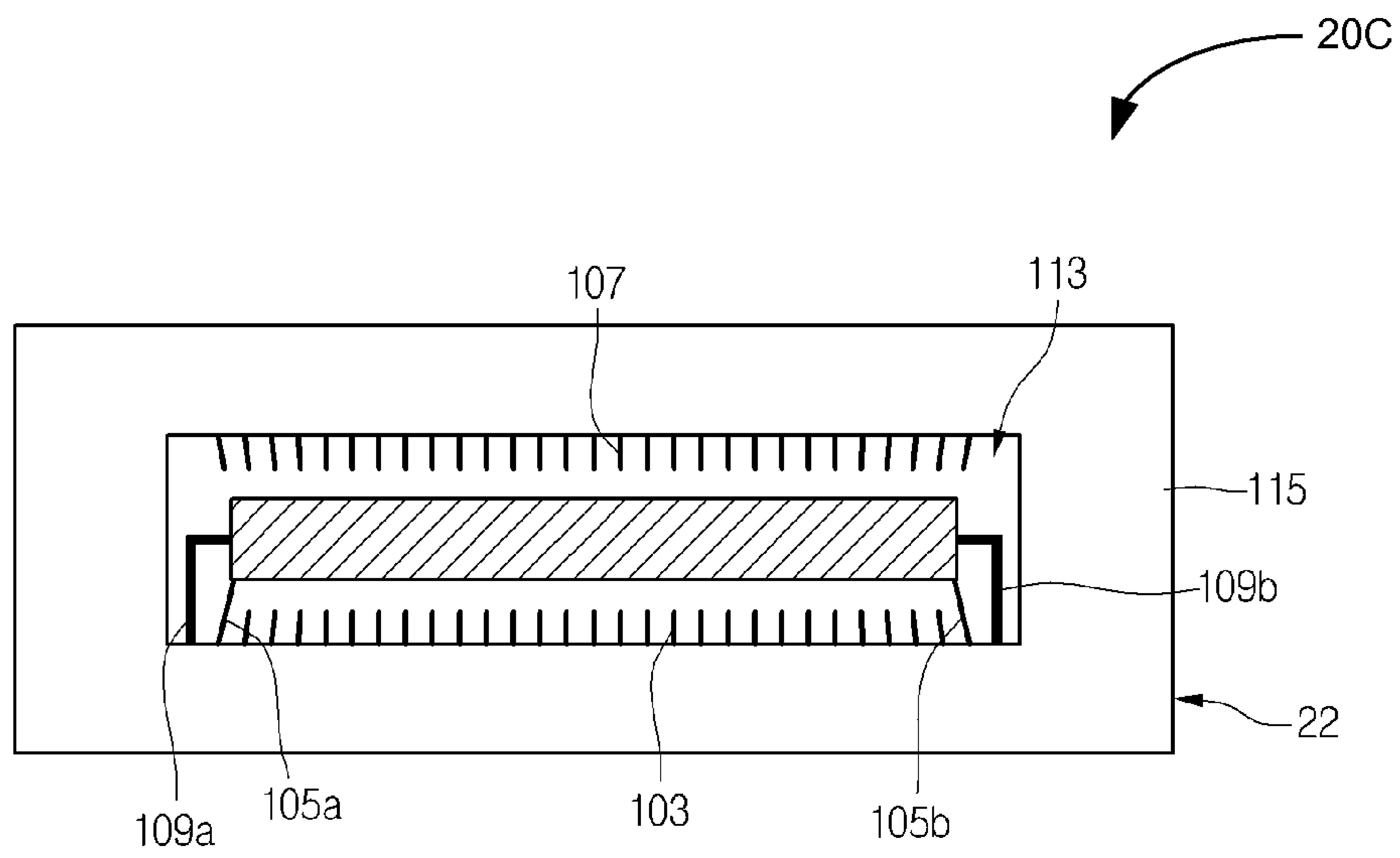


FIG. 6

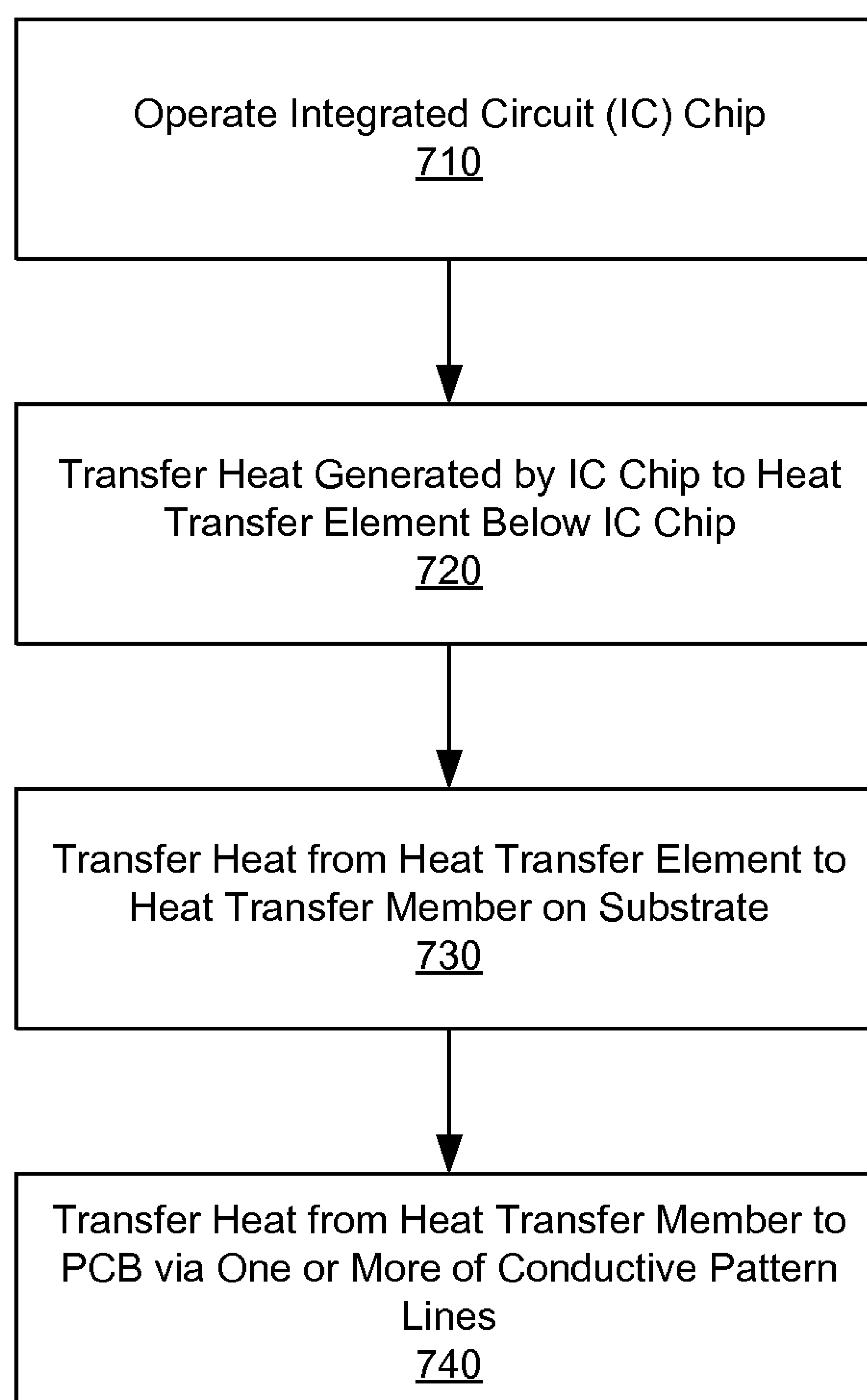


FIG. 7

DRIVER PACKAGE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. 119(a) to Korean Patent Application No. 10-2011-0100909, filed on Oct. 4, 2011, which is hereby incorporated by reference in its entirety.

BACKGROUND

1. Field of the Disclosure

This disclosure relates to transferring heat generated by an integrated circuit (IC) chip of a driver assembly for supplying operating signals to a display device to prevent overheating of the IC chip.

2. Description of the Related Art

Display devices are used for displaying information on a display panel for visual interaction with users. Various types of display technologies were developed and currently available for use in electronic devices. The display devices may incorporate various types of technology including, among others, liquid crystal display (LCD) technology, organic light emitting display (OLED) technology, electrophoretic display technology, field emission display (FED) technology, and plasma display technology. In general, display devices include a display panel and a driver assembly for providing signals to operate pixel elements in the display panel.

One conventional way of implementing the driver assembly is by using chip-on-film (COF) technology. The COF generally uses a film (e.g., flexible substrate) and a driver integrated circuit (IC) chip mounted on the film. Wiring patterns are formed on the film and bumps are placed between the driver IC and the film to connect the driver IC to the wiring patterns. The wiring patterns connect the IC chip to signal lines of a display panel.

As the size of the display panel increases, the operating frequency and the operating voltage of the driver IC chip also increases. The increased frequency and the operating voltage of the driver IC increases the heat generated within the driver IC. Such increase the internal heat generation can cause the driver IC to overheat, resulting in malfunctioning as well as damage to the driver IC chip. The heating of the driver IC chip can compromise the reliability of the display device.

SUMMARY

Embodiments relate to a driver assembly with an efficient mechanism for transferring heat away from an integrated circuit (IC) chip via a heat transfer member and conductive pattern lines formed on a substrate. The IC chip is mounted on connectors and is placed above the substrate. The IC chip operatively communicates with the display panel via at least a subset of the conductive pattern lines and a subset of the connectors. A heat transfer member is formed on the substrate and is configured to transfer heat generated by the integrated circuit to a component having a lower temperature than the IC chip. A heat transfer element is placed between the IC chip and the heat transfer member to transfer the heat generated by the IC chip to the heat transfer member.

In one or more embodiments, the driver assembly is a chip on film (COF) device.

In one or more embodiments, the driver assembly includes an electrically insulating layer partly covering the conductive pattern lines. The connectors are placed on the part of the conductive pattern lines not covered by the electrically insulating layer and extend between the conductive pattern lines and the IC chip.

In one or more embodiments, the drive assembly generates signals for transmission over scan lines or data lines of the display panel.

In one or more embodiments, the conductive pattern lines include one or more lines connecting the heat transfer member and the component to transfer heat from the heat transfer member to the component.

In one or more embodiments, the one or more lines further carry electric signals or reference voltage to or from the IC chip.

In one or more embodiments, the heat transfer element is formed on or attached to a bottom of the IC chip. The heat transfer element may have a flat configuration with an area smaller than the bottom surface of the IC chip.

In one or more embodiments, the heat transfer element is a filler material injected between the IC chip and the heat transfer member. The filler material is electrically non-conductive but thermally conductive. The filler material may cover an entire bottom surface of the IC chip.

In one or more embodiments, the heat transfer member and the plurality of conductive pattern lines are formed in the same fabrication process and are formed of the same material. The fabrication process may include depositing a layer of conductive film on the substrate and etching the deposited film.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view illustrating a display device according to one embodiment.

FIG. **2** is a plan view illustrating a first driver assembly in the display device of FIG. **1**, according to a first embodiment.

FIG. **3** is a cross-sectional view illustrating the first driver assembly of FIG. **2**.

FIG. **4** is a cross-sectional view illustrating the driver integrated circuit (IC) chip attached with a second heat transfer member.

FIG. **5** is a cross-sectional view illustrating a first driver assembly according a second embodiment.

FIG. **6** is a plan view illustrating a first driver assembly according a third embodiment.

FIG. **7** is a flowchart illustrating a method for transferring heat from the driver IC chip to a printed circuit board, according to one embodiment.

DETAILED DESCRIPTION

Reference will now be made in detail to the present embodiments, examples of which are illustrated in the accompanying drawings.

FIG. **1** is a plan view showing a display device **100** according to an embodiment. The display device **100** may be embodied using various technologies. For example, the display device **100** may be any one of a liquid crystal display (LCD) device, an organic light emitting display (OLED) device, an electrophoretic display device, a field emission display (FED) device and plasma display device.

The display device **100** according to the embodiment can include, among other components, a display panel **10**, a first driver assembly **20**, a second driver assembly **40** and a printed circuit board (PCB) **30**. The display device **100** may include various other components such as a power source and communication interfaces, which are omitted herein for the sake of brevity.

The display panel **10** can include a plurality of pixel regions defined by a plurality of scan lines and a plurality of data lines crossing each other. The plurality of pixel regions can be arranged in a matrix, for example. The plurality of scan lines can be electrically connected to the first driver assembly **20**. The plurality of data lines can be electrically connected to the second driver assembly **40**. The pixel regions in a line can be selected by scan signals that are applied, for example, sequentially. By applying data signals to the data lines, one or more pixels in the selected pixel regions can be turned on or off.

The first driver assembly **20** generates the scan signals carried over a plurality of scan lines (not shown). For this purpose, the first driver assembly **20** can include, among other components, a first driver IC chip **25**. The first driver IC chip **25** generates the scan signals for turning on or off pixels in the scan lines of the display panel **10**.

The second driver assembly **40** generates the data signals for carrying over a plurality of data lines (not shown). For this purpose, the second driver assembly **40** can include, among other components, a second driver IC chip **45**. The second driver IC chip **45** receives external signals from the PCB **30** and, in response, generates the data signals for turning on or off pixels in the data lines of the display panel **10**.

As the size of the display panel **10** increases, the voltage level and/or the frequency of the scan signals and the data signals are increased. Such increase in the voltage level and/or frequency of the scan signals and the data signals accompanies increase in the internal heat generated by the first driver IC chip **25** and the second driver IC chip **45**. Embodiments described herein enable effective removal of the internal heat generated in the first and second driver IC chips **25** and **45** outside of the display device **30** via PCB **30** or other components.

Although the following descriptions are described below primarily with reference to the first driver assembly **20**, the embodiments described with reference to FIGS. **2** through **7** can be applied to the second driver IC assembly **40**. That is, the second driver assembly **40** may have the same or similar structure as the first driver assembly **20** to remove the heat generated in the second driver IC chip **45**.

FIG. **2** is a plan view illustrating a first driver assembly **20**A of the display device **100**, according to a first embodiment. FIG. **3** is a cross-sectional view illustrating the first driver assembly **20**A taken along line I-I' of FIG. **2**. The first driver assembly **20**A can include, among other components, a substrate member **22**, the first driver IC chip **25**, a first heat transfer member **101** and a second heat transfer member **125**. The first IC chip **25** is mounted on the substrate member **22** to form a chip-on-film (COF) device. The first and second heat transfer members **101** transfers heat from the first IC chip **25** to the PCB **30**.

The substrate member **22** can include, among others, a substrate **111**, conductive pattern lines **103** on the substrate **111**, and an insulation film **115** on the conductive pattern lines **103**. The substrate **111** can be formed from a flexible material such as plastic or glass. Alternatively, the substrate **111** can be a thin layer of metal having a foil shape.

The conductive pattern lines **103** are formed of electrically conductive material. The conductive pattern lines **103** are sandwiched between the substrate **111** and the insulation film **115** except for a region corresponding to an opening **113** where the conductive pattern lines **103** are exposed for connection to the first driver IC **25** via bumps **127***a*, **127***b*. Such conductive pattern lines **103** can include, among other lines, a first signal line **106**, a second signal line **107**, a first ground line **105***a* and a second ground line **105***b*. The first signal line **106**, the second signal line **108**, the first ground line **105***a* and the second ground line **105***b* can be electrically connected to the PCB **30** to receive signals and power.

The conductive pattern lines **103** may include a single layer or multiple layers. One or more layers of the conductive pattern lines **103** may include materials such as gold, aluminum, silver, titanium, copper, nickel, platinum, molybdenum, tungsten, tantalum and chromium.

In one or more embodiments, the conductive pattern lines **103** are formed by depositing a conductive film on the substrate **111** and etching the conductive film, as well known in the art.

The first signal line **106**, the first ground line **105***a* and the second ground lines **105***a* can be electrically connected to the PCB **30** through extra conductive pattern lines (not shown) formed on the display panel **10** and the second driver assembly **40**.

The first signal line **106**, the second signal line **107** and the ground lines **105***a*, **105***b* can be used to carry various signals. For example, the first signal line **106** can be used to transfer a scan control signal sent from the PCB **30** to the first driver IC chip **25**. The first and second ground lines **105***a* and **105***b* can be connected to a reference voltage source (e.g., GND) and/or transfer heat generated in the first driver IC chip **25**. The second signal line **107** can provide a signal path for sending a scan signal from the first driver IC chip **25** to a scan line on the display panel **10**.

The insulation film **115** insulates the conductive pattern lines **103** from external environment to prevent external contaminants from short-circuiting the conductive pattern lines **103**. An opening **113** can be formed in a central area of the substrate member **22** by removing the insulation film **115**. The conductive pattern lines **103** (e.g., first and second signal lines **106**, **107** and the first and second ground lines **105***a* and **105***b*) are exposed in the opening **113** to enable these lines to come in contact with the first driver IC **25** via bumps (e.g., bumps **127***a*, **127***b*). The first signal line **103**, the first ground line **105***a*, second ground line **105***b* and the second signal line **107** are spatially separated in the opening **113** to prevent these lines from coming into contact with each other.

The first driver IC chip **25** can be mounted above the opening **113** of the substrate member **22**. One side (e.g., the left side in FIG. **3**) of the first driver IC chip **25** can be electrically connected to the first signal line **106**, the first ground line **105***a* and the second ground line **105***b*. The other side (e.g., the right side in FIG. **3**) of the first driver IC chip **25** can be electrically connected to the second signal line **107**.

As illustrated in FIG. **3**, a first heat transfer member **101** is formed on an area of substrate **111** exposed by the opening **113**. The first heat transfer member **101** is surrounded by conductive pattern lines **103**. The first heat transfer member **101** can be formed by the fabrication process for forming the first and second signal lines **106** and **107** and the first and second ground lines **105***a* and **105***b*. Consequently, the first heat transfer member **101** may be of the same material as and formed in the same layer as the first and second signal lines **106** and **107** and the first and second ground lines **105***a* and **105***b*. The fabrication process may include depositing a film on the substrate **111** and then etching the film.

The first heat transfer member **101** can be electrically insulated from the first and second signal lines **103** and **107**. For this purpose, the first and second signal lines **106** and **107** can be spaced away from the first heat transfer member **101**.

The first and second ground lines **105***a* and **105***b* can be electrically connected to the first heat transfer member **101**. The first heat transfer member **101** can remove heat generated

in the first driver assembly **20**A via the first and second ground lines **105***a*,**105***b* and the PCB **30**.

The first heat transfer member **101** can be formed from a thermally conductive resin material such as epoxy or silicon. The first heat transfer member **101** can be prepared by forming a liquid resin material on the substrate member **22** within the opening **113** and curing the liquid resin material into a hard solid. Alternatively, the first heat transfer member **101** may be a tape formed from a resin material on the substrate member **22** exposed to the opening **113**.

FIG. **4** is a cross-sectional view illustrating the first driver IC chip **25** attached with a second heat transfer member **125**, according to one embodiment. The second heat transfer member **125** can be formed on or attached to the bottom surface of the first driver IC chip **25**. The second heat transfer member **125** comes into contact with the first heat member **101** to transfer heat from the body of the first driver IC **25** to the first heat transfer member **101**. The second heat transfer member **125** can be formed, for example, as a tape attached to a bottom surface of the first driver IC chip **25**. The tape comes into surface contact with both the first heat transfer member **125** and the first driver IC chip **25** and can be made of resin materials such as epoxy or silicon. Heat generated in the first driver IC chip **25** is transferred to the first heat transfer member **101** on the substrate member **22** through the second heat transfer member **125**, and then transferred from the first heat transfer member **101** to the printed circuit board **30** via the first and second ground lines **105***a*, **105***b*.

The embodiment of FIGS. **2** and **3** enable efficient removal of heat from the first driver IC chip **25** to the PCB **30** via a heat transfer path including the second heat transfer member **125**, the first heat transfer member **101** and the first and second ground lines **105***a* and **105***b*.

FIG. **5** is a cross-sectional view showing a first driver assembly **20**B according a second embodiment. The first driver assembly **20**B is substantially the same as the first driver assembly **20**A of FIGS. **2** and **3** except that a heat transfer filler **130** is provided between the substrate member **22** and the first driver IC chip **25** instead of the second heat transfer member **125**. Description of components in the second embodiment having the same function as those of the first embodiment will be omitted herein for the sake of brevity.

The first driver assembly **20**B may include, among other components, a substrate member **22**, a first driver IC chip **25**, a heat transfer member **101** and a heat transfer filler **130**. The heat transfer filler **130** can be formed between the substrate member **22** an the first driver IC chip **25** to cover the opening **113** of the substrate member and the circumference thereof. In other words, the heat transfer filler **130** can be formed not only on the first and second signal lines **103** and **107**, the first and second ground lines **105***a* and **105***b*, the heat transfer member **101** and the substrate **111** exposed by the opening **113**, but also on the inner edge area of the insulation film **115** adjacent to the opening **113**.

The heat transfer filler **130** can be formed from a material that is electrically non-conductive but thermally conductive. The heat transfer filler **130** is electrically non-conductive, and hence, electrical short between the first driver IC chip **25** and the first and second signal lines **103** and **107** is prevented. The heat transfer filler **130** can be formed from materials such as an epoxy-based material or a silicon-based material.

After filling the thermally conductive filler **130** and forming the first and second bumps **127***a*, **127***b* on the substrate member **22**, the first driver IC chip **25** is depressed to connect the first and second signal lines **103** and **107** on the substrate member **22** to the conductive pattern lines **103** using the first and second bumps **127***a* and **127***b*. Subsequently, the heat transfer filler **130** can be cured through a curing process using heat or laser beam.

In order to increase the amount of heat transferred, it is advantageous to have the heat transfer filler **130** come into contact with the first driver IC chip **25** as much as possible. The heat transfer filler **130** can be formed to make contact with the entire rear-surface of the first driver IC chip **25**.

The second embodiment enables heat generated in the first driver IC chip **25** to be transferred to the heat transfer member via a heat transfer path including the heat transfer filler **130**, the heat transfer member **101**, the first ground line **105***a* and the second ground line **105***b*.

FIG. **6** is a plan view illustrating a first driver assembly **20**C according a third embodiment. The first driver assembly **20**C is substantially the same as the first driver assemblies **20**A and **20**B except that the first driver assembly **20**C includes extra heat transfer lines **109***a*, **109***b* connected to the first heat transfer member **101** in addition to the first and second ground lines **105***a*, **105***b* of the first driver assembly **20**A. Description of components in the first driver assembly **20**C having the same function as those of the first driver assembly **20**A will be omitted herein for the sake of brevity.

The conductive pattern lines **30** in the first driver assembly **20**C include the first and second heat transfer lines **109***a*, **109***b* in addition to the first and second signal lines **106**, **107** and the first and second ground lines **105***a*, **105***b*.

Unlike the first driver assembly **20**A, the first and second ground lines **105***a*, **105***b* can be disconnected from the first heat transfer member **101** since the first and second heat transfer lines **109***a*, **109***b* form a heat path to transfer the heat from the first driver IC **25**.

The first and second heat transfer lines **109***a*, **109***b* can be simultaneously formed using the same process for forming the first heat transfer member **101**, the first and second signal lines **103** and **107**, and the first and second ground lines **105***a* and **105***b*. Therefore, the first and second heat transfer lines **109***a*, **109***b* may be made in the same layer and made from the same material as the first and second signal lines **106** and **107**, and the first and second ground lines **105***a*, **105***b*.

To increase the heat transfer, each of the first and second heat transfer lines **109***a*, **109***b* can have a width wider than the first and second signal lines **106**, **107**. If an extra margin remains in the substrate member **22**, the first and second heat transfer lines **109***a*, **109***b* can be formed to have a wider width to increase the heat transfer.

FIG. **7** is a flowchart illustrating a method for transferring heat from the driver IC chip **25** to the PCB **30**, according to one embodiment. The driver IC chip **25** is operated **710** to generate signals to the display panel **10**. The generated signals may be scan signals transmitted over the scan lines of the display panel **10** or data signals transmitted over the data lines of the display panel **10**. As a result of the operation, heat is generated by the driver IC chip **25**.

The heat generated by the driver IC chip **25** is transferred **720** to a heat transfer element below the bottom surface of the driver IC chip **25**. The heat transfer element may be the heat transfer member **125** (see FIGS. **3** and **4**) or the heat transfer filler **130** (see FIG. **5**).

The heat is then transferred **730** from the heat transfer element to the heat transfer member **101** formed on the substrate **111**. The heat is then transferred **740** from the heat transfer member **101** to a component (e.g., PCB) with a lower temperature via one or more conductive pattern lines **103** formed on the substrate **111**.

Embodiments allow heat generated in a driver IC chip of a COF to be effectively transferred to other components (e.g.,

the PCB **30**) via a heat path including a heat transfer member. By reducing the temperature of the driver IC chip, malfunction and damage of the driver IC chip can be prevented.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A display device comprising:
a display panel including a plurality of pixel regions; and
a driver assembly connected to the display panel and configured to generate signals for operating the display panel, the driver assembly comprising:
a substrate;
a plurality of conductive pattern lines formed on the substrate;
an integrated circuit (IC) chip mounted on connectors and placed above the substrate, the IC chip operatively communicating with the display panel via at least a subset of the plurality of conductive pattern lines and at least a subset of the connectors;
a heat transfer member formed on the substrate and configured to transfer heat generated by the IC chip to a component connected to the driver assembly; and
a heat transfer element between the IC chip and the heat transfer member to transfer the heat generated by the IC chip to the heat transfer member.

2. The display device of claim **1**, wherein the driver assembly is a chip on film (COF) device.

3. The display device of claim **1**, wherein the driver assembly further comprises an electrically insulating layer partly covering the conductive pattern lines, wherein the connectors are placed on the conductive pattern lines not covered by the electrically insulating layer to extend between the conductive pattern lines and the IC chip.

4. The display device of claim **1**, wherein the drive assembly generates signals for transmission over scan lines or data lines of the display panel.

5. The display device of claim **1**, wherein the conductive pattern lines comprise one or more lines connecting the heat transfer member and the component to transfer heat from the heat transfer member to the component.

6. The display device of claim **5**, wherein the one or more lines are connected to a reference voltage source.

7. The display device of claim **5**, wherein the one or more lines have a first width wider than other conductive pattern lines for carrying signals between the IC chip and the display panel.

8. The display device of claim **5**, wherein the one or more lines further carry electric signals or reference voltage to or from the IC chip.

9. The display device of claim **1**, wherein the heat transfer element is formed on or attached to a bottom of the IC chip.

10. The display device of claim **1**, wherein the heat transfer element comprises a filler material injected between the IC chip and the heat transfer member, wherein the filler material is electrically non-conductive but thermally conductive.

11. The display device of claim **9**, wherein the filler material covers an entire bottom surface of the IC chip.

12. The display device of claim **1**, wherein the heat transfer member and the plurality of conductive pattern lines are formed in a same fabrication process and are formed of a same material.

13. The display device of claim **12**, wherein the fabrication process comprises depositing a layer of conductive film on the substrate and etching the deposited film.

14. The display device of claim **1**, wherein the heat transfer member is formed by injecting and curing a thermally conductive resin material or by attaching a tape formed of a resin material on the substrate.

15. The display device of claim **1**, further comprising another driver assembly configured to generate signals for operating the display panel.

16. A method for transferring heat from an integrated circuit (IC) chip in a display device, comprising:
operating the IC chip to provide signals to a display panel of the display device;
transferring heat generated by operation of the IC chip to a heat transfer element placed below the IC chip;
transferring heat from the heat transfer element to a heat transfer member formed on a substrate; and
transfer heat from the heat transfer member to a component via one or more conductive pattern lines formed on the substrate.

17. The method of claim **16**, wherein the heat transfer element is a flat member attached to the IC chip or a filler material.

18. The method of claim **16**, further comprising transmitting electric signals or reference voltage over the one or more conductive pattern lines.

19. The method of claim **16**, wherein the heat transfer member and the one or more conductive pattern lines are formed in a same fabrication process and are formed of a same material.

20. A driver assembly for generating operation signals of a display panel, the driver assembly comprising:
a substrate;
a plurality of conductive pattern lines formed on the substrate;
an integrated circuit (IC) chip mounted on connectors and placed above the substrate, the IC chip operatively communicating with the display panel via at least a subset of the plurality of conductive pattern lines and a subset of the plurality of conductive pattern lines;
a heat transfer member formed on the substrate and configured to transfer heat generated by the IC chip to a component connected to the driver assembly; and
a heat transfer element between the IC chip and the heat transfer member to transfer the heat generated by the IC chip to the heat transfer member.

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